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# SOPHISTICATED JAMMERS AND ADAPTIVE ARRAYS

The Ohio State University

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Naval Air Systems Command
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This report describes progress under Naval Air Systems Command Contract N00019-81-C-0093 during the first quarterly period. Research on the behavior of adaptive arrays with sophisticated jammers is summarized.

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TABLE OF CONTENTS

## I. INTRODUCTION

This report describes progress under Naval Air Systems Command Contract N00019-81-C-0093 during the first quarterly period. This contract involves studies on the effectiveness of two types of jamming against adaptive arrays: envelope modulated jammers and cross-polarized jammers.

During the first quarter of this contract, we have concentrated on envelope modulated jammers. Our progress is described below.

## II. PROGRESS

Studies have been conducted in two areas related to envelope modulated jamming:

### 1. A Jammer with Sinusoidal Envelope Modulation

Our ultimate objective in this work is to determine the behavior of an adaptive array when subjected to jammers with arbitrary periodic modulation. A number of interesting jammers can be modeled in this form. To determine the array behavior for this class of problem, one must solve a system of differential equations with periodic coefficients. There appear to be no standard methods for doing this.

At this writing, we have found a technique that can be used to treat interference with a carrier component and one sideband on each side of the carrier. Thus, this technique can be used to handle interference with sinusoidal envelope modulation. It could also be used to treat interference with narrowband sinusoidal phase or frequency modulation. We believe that this technique can be extended to interference with arbitrary periodic modulation.

We are currently evaluating the effect on array performance of a single jammer with sinusoidal envelope modulation. Our purpose is both to test the mathematical method and also for the results themselves. Such jamming affects the array in the same general way that a pulsed jammer does. (The effects of a pulsed jammer are described in [1].) It causes the array weights to vary periodically and thus results in a periodic modulation of the desired signal. It also causes the signal-to-interference-plus-noise ratio (SINR) at the array output to vary periodically. This SINR variation increases the bit error rate in a digital communication system. A report detailing this work is planned.

2. Eigenvalue Behavior in Adaptive Arrays

During this quarter we have also done a numerical study of the eigenvalue behavior in adaptive arrays. This information is needed in connection with our work on modulated jamming. Since the array responds to signals at a rate determined by the eigenvalues, it is helpful to have numerical data on how the eigenvalues actually depend on signal powers, arrival angles, number of elements, element spacings, etc. (Although the problem of eigenvalue spread is well-known, almost no actual data appear to be available in the literature showing how the eigenvalues depend on signal and array parameters. The purpose of this work is to generate such data.) A report on this subject is in preparation.

## III. REFERENCES

1. R.T. Compton, Jr., "The Effect of a Pulsed Interference Signal on an Adaptive Array," Technical Report 712684-8, April 1981, The Ohio State University ElectroScience Laboratory, Department of Electrical Engineering; published under Contract N00019-80-C-0181 for Naval Air Systems Command, Department of the Navy, Washington, D.C., 20361.


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